15 – Straw Bale Barrier

Definition

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales.

Purposes

To intercept and detain small amounts of sediment from disturbed areas of limited extent in order to prevent sediment from leaving the logging site and/or entering stream channels.

To decrease the velocity of sheet flows.

Conditions Where Practice Applies

- Below disturbed areas subject to sheet and rill erosion such as haul roads, log decks, and skid trails.
- Where the size of the drainage area is no greater than one-fourth of an acre per 100 feet of barrier length; the maximum slope length behind the barrier is 100 feet; and the maximum slope gradient behind the barrier is 50% (2:1).
- Where effectiveness is required for less than 3 months.
- Straw bale barriers should *not* be constructed in live streams.
- This measure should not be used where water may concentrate in defined ditches.

Straw bale barriers should *not* be used on areas where rock or another hard surface prevents the full and uniform anchoring of the barrier.

Straw bale barriers are poor filters of sediment if not properly installed and maintained. In cases where the barrier is not properly installed and maintained, the measure can create additional problems.

Locate the straw bale barrier at least 5-7 feet from the base of disturbed slopes with grades greater than 7%.

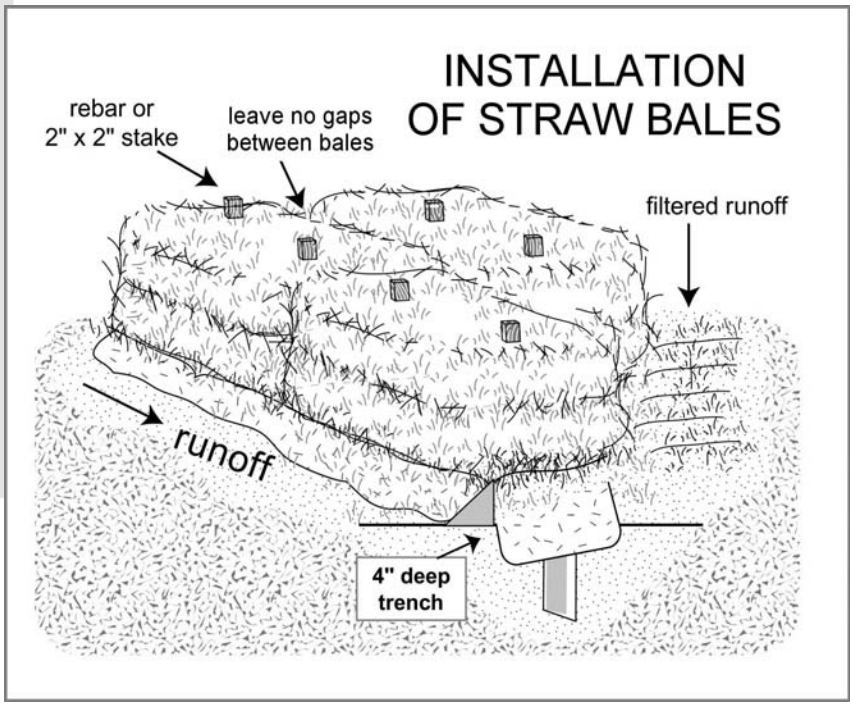
Recommended Installation

1. Bales should be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.

2. All bales should be wire-bound or string-tied. Straw bales should be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings.

3. The barrier should be entrenched and backfilled. A trench should be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging), the excavated soil should be backfilled against the barrier. Backfill soil should conform to the ground level on the downhill side and should be built up to 4 inches against the uphill side of the barrier.

4. Each bale should be securely anchored by at least two stakes (minimum dimensions 2 inches x 2 inches x 36 inches) or standard "T" or "U" steel posts (minimum weight of 1.33 pounds per linear foot) driven through the bale. The first stake or steel post in each bale should be driven toward the previously laid bale to force the bales together. Stakes or steel pickets should be driven a minimum 18 inches into the ground to securely anchor the bales.



5. The gaps between bales should be chinked with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency.Inspection should be frequent and repair or replacement should be made promptly as needed.

Straw bale barriers should be removed when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

Straw bale barriers should be inspected immediately after each rainfall and at least daily during prolonged rainfall.

Close attention should be paid to the repair of damaged bales, end runs, and undercutting beneath bales.

Sediment deposits must be removed when the level of deposition reaches approximately one-half the height of the barrier.

Any sediment deposits remaining in place after the straw bale barrier is no longer required should be dressed to conform to the existing grade, prepared, and seeded.

16 – Silt Fence

Definition

A temporary sediment barrier consisting of a synthetic filter fabric stretched across and attached to supporting posts and entrenched.

Purposes

To intercept and detain small amounts of sediment from disturbed areas during logging operations to prevent sediment from leaving the site.

To decrease the velocity of sheet flows and low-to-moderate level channel flows.

Conditions Where Practice Applies

- Below disturbed areas where erosion would occur in the form of sheet and rill erosion.
- Where the size of the drainage area is no more than one quarter acre per 100 feet of silt fence length; the maximum slope length behind the barrier is 100 feet; and the maximum gradient behind the barrier is 50 percent (2:1).
- In minor swales or ditch lines where maximum contributing drainage area is no greater than 1 acre and flow is no greater than 1 cfs.
- Silt fence should not be used in areas where rock or other hard surfaces prevent the full and uniform depth anchoring of the barrier.

Silt fence will trap a much higher percentage of suspended sediments than straw bales because the silt fence passes the sediment-laden water more slowly. Silt fences are preferable to straw barriers in many cases because of their durability and potential cost savings. While the failure rate of silt fences is lower than that of straw barriers, improperly installed silt fences invite failure and sediment loss. The installation methods outlined here can improve performance and reduce failures.

As noted, flow rate through silt fence is significantly lower than the flow rate for straw bale barriers. This creates more ponding and, therefore, more time for sediment to fall out.

Both woven and non-woven synthetic fabrics are available commercially. The woven fabrics generally display higher strength than the non-woven fabrics and, in most cases, do not require any additional reinforcement. When tested under acid and alkaline water conditions, most of the woven fabrics increase in strength, while the reactions of non-woven fabrics to these conditions are variable. The same is true of testing under extensive ultraviolet radiation. Permeability rates vary regardless of fabric type. While all the fabrics demonstrate very high filtering efficiencies for sandy sediments, there is considerable variation among both woven and non-woven fabrics when filtering the finer silt and clay particles.

1. As with strawbale barriers, an effort should be made to locate silt fence at least 5 to 7 feet beyond the base of disturbed slopes with grades greater than 7%.

2. The use of silt fence, because they have such a low permeability, is limited to situations in which only sheet flow or overland flows are expected and where concentrated flows originate from drainage areas of 1 acre or less.

3. Field experience has demonstrated that silt fence is often installed too short (less than 16 inches above ground elevation). The short fence is subject to breaching during even small storm events and will require maintenance "clean outs" more often. Properly supported silt fence that stands 24 to 34 inches above the existing grade tends to promote more effective sediment control.

Materials

1. Synthetic filter fabric should be a pervious sheet of propylene, nylon, polyester or ethylene yarn and should be certified by the manufacturer or supplier.

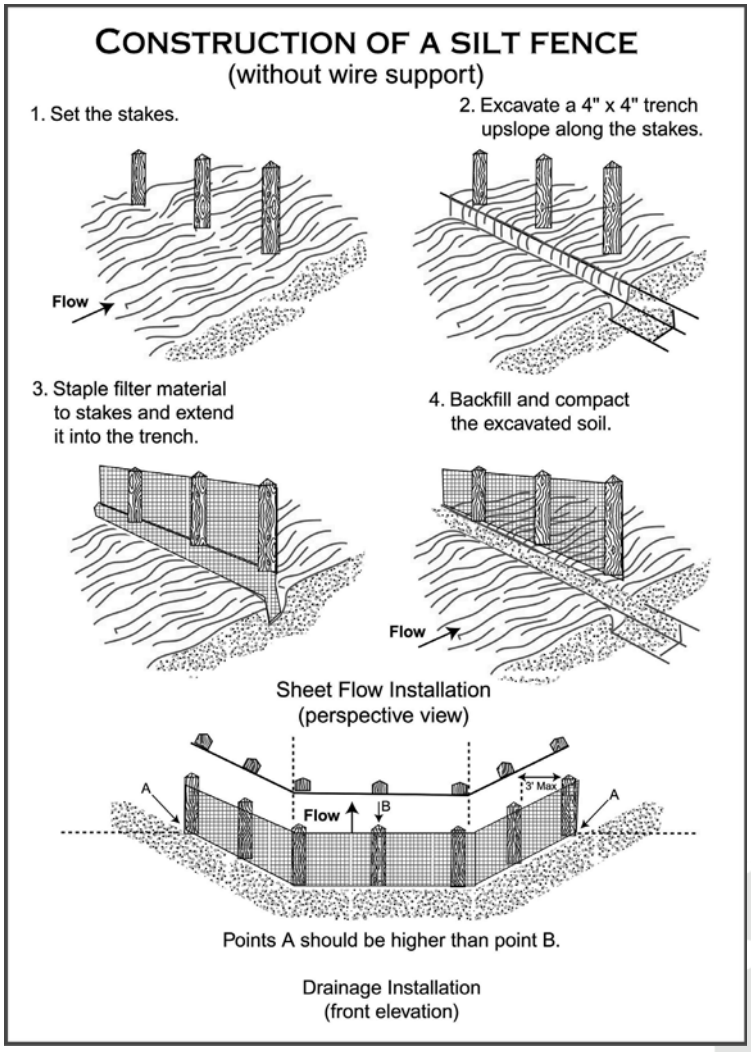
2. Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0° to 120° F.

3. If *wooden stakes* are used for silt fence construction, they should have a diameter of 2 inches when oak is used and 4 inches when pine is used. Wooden stakes should have a minimum length of 5 feet. Some silt fence comes with preinstalled stakes that meet the manufacturer's standards; these are adequate for forestry uses.

If *steel posts* (standard "U" or "T" section) are used for silt fence construction, they *must* have a minimum weight of 1.33 pounds per linear foot and should have a minimum length of 5 feet.

Wire fence reinforcement for silt fence using standard-strength filter cloth should be a minimum of 14 gauge and should have a maximum mesh spacing of 6 inches.

The height of a silt fence should be a minimum of 16 inches above the original ground surface and should not exceed 34 inches above ground elevation.



The filter fabric should be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter cloth should be spliced together only at a support post, with a minimum 6-inch overlap, and be sealed securely.

A trench should be excavated approximately 4-inches wide and 4-inches deep on the upslope side of the proposed location of the silt fence.

When *wire support is used*, standard-strength filter cloth may be used. Posts for this type of installation should be placed a maximum of 10 feet apart. The wire mesh fence should be fastened securely to the upslope side of the posts using heavy duty wire staples at least one inch long, tie wires, or hog rings. The wire should extend into the trench a minimum of 2 inches and should not extend more than 34 inches above the original ground surface. The standard-strength fabric should be stapled or wired to the wire fence, and 8 inches of the fabric should be extended into the trench. The fabric should not be stapled to existing trees.

When wire support is not used, extra-strength filter cloth should be used. Posts for this type of fabric should be placed a maximum of 6 feet apart. The filter fabric should be fastened securely to the upslope side of the posts using 1-inch long (minimum) heavy-duty wire staples or tie wires and eight inches of the fabric should be extended into the trench. The fabric should not be stapled to trees.

If a silt fence is to be constructed across a ditch line or swale, the measure should be of sufficient length to eliminate endflow, and the plan configuration should resemble an arc or horseshoe with the ends oriented upslope. Extra-strength filter fabric with a maximum 3-foot spacing of posts should be used for this application.

The 4-inch by 4-inch trench should be backfilled and the soil compacted over the filter fabric.

Silt fences should be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

Silt fence should be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs should be made immediately.

Close attention should be paid to the repair of silt fence damaged by end runs and undercutting.

Should the fabric on a silt fence decompose or become ineffective prior to the end or the expected usable life and the barrier still be necessary, the fabric should be replaced promptly.

Sediment deposits should be removed after each storm event. They should be removed when deposits reach approximately one-half the height of the barrier.

Any sediment deposits remaining in place after the silt fence is no longer required should be graded to conform with the existing road grade, prepared and seeded.

17 – Brush Barriers

Definition

A temporary sediment barrier constructed at the perimeter of a disturbed area such as log decks within the SMZ, or skid trails in the bottoms of swales.

Purpose

To intercept and retain sediment from disturbed areas of limited extent, preventing sediment from leaving the site.

Conditions Where Practice Applies

- Below disturbed areas subject to sheet and rill erosion, where enough residue material is available for construction of such a barrier
- Where the size of the drainage area is no greater than 1/4 of an acre per 100 feet of barrier length; the maximum slope length behind the barrier is 100 feet; and the maximum slope gradient behind the barrier is 50 percent (2:1).

Planning Considerations

Slash from the logging operation and organic litter, spoil material, and woody debris from clearing logging decks and haul roads are usually piled nearby. Much of this material can be used effectively on the site. During the logging operation, equipment can push and pile the mixture of limbs, small vegetation and root mat into windrows along the toe of a slope where erosion and accelerated runoff are expected. Because brush barriers are fairly stable and composed of natural materials, maintenance requirements are small. Field experience has shown, however, that many brush barrier installations are not effective when there are large voids created by the use of material that is too large to provide a compact, dense barrier. It is necessary to use residual material less than 6 inches in diameter that will create a more uniform barrier, or use a filter fabric overlay to promote enhanced filtration of sediment-laden runoff.

Recommended Construction Specifications

Without Filter Cloth

- The height of a brush barrier should be a minimum of 3 feet.
- The width of a brush barrier should be a minimum of 5 feet at its base. The sizes of brush barriers may vary considerably based upon the amount of material available and the judgment of the operator.
- The barrier should be constructed by piling brush, stone, root mat and other material from the logging process into a mounded row on the contour. Material larger than 6 inches in diameter should not be used to create the mound as the non-homogeneity of the mixture can lead to voids where sediment-laden flows can easily pass.

If a Filter is Used

- The filter fabric should be cut into lengths sufficient to lay across the barrier from its up-slope base to just beyond its peak. Where joints are necessary, the fabric should be spliced together with a minimum 6-inch overlap and sealed securely.
- A trench 6-inches wide and 4-inches deep should be excavated along the length of the barrier and immediately uphill from the barrier.
- The lengths of filter fabric should be draped across the width of the barrier with the up hill edge placed in the trench and the edges of adjacent pieces overlapping each other.
- The filter fabric should be secured in the trench with stakes set approximately 36 inches on center.
- The trench should be backfilled and the soil compacted over the filter fabric.
- Set stakes into the ground along the uphill edge of the brush barrier, and anchor the fabric by tying twine from the fabric to the stakes.
- Brush barriers should be inspected after each rainfall and necessary repairs should be made promptly. Sediment deposits should be removed when they reach approximately one-half the height of the barrier.

18 – Surface Roughening

Definition

Providing a rough soil surface with horizontal depressions created by operating a tillage or other suitable implement on the contour, or by leaving slopes in a roughened condition by not fine-grading them.

Purpose

To aid in establishment of vegetative cover with seed.

To reduce runoff velocity and increase infiltration.

To reduce erosion and provide for sediment trapping.

Conditions Where Practice Applies

- Haul roads, log decks, skid trails, and other areas requiring cut and fill slopes.
- All slopes steeper than 3:1 should be surface roughened by stair-stepped grading, grooving, furrowing, or tracking in order to stabilize with vegetation.
- Areas with grades less steep than 3:1 should have the soil surface lightly roughened and loosened to a depth of 2 to 6 inches prior to seeding.
- Areas that have been graded and will not be stabilized immediately (within 7 days) should be roughened to reduce runoff velocity until seeding takes place.
- Install on cut slopes and fill slopes of haul roads, log decks, skid trails, etc.
- Slopes with a stable rock face do not require roughening or stabilization.

Planning Considerations

It is difficult to establish vegetation on graded or fill areas with smooth, hard surfaces due to reduced water infiltration and the potential for erosion. Rough slope surfaces with uneven soil and small rocks left in place encourage water infiltration, speed the establishment of vegetation, and decrease runoff velocity.

Rough, loose soil surfaces give lime, fertilizer and seed some natural coverage. Niches in the surface provide microclimates that generally provide a cooler and more favorable moisture level than hard flat surfaces; this aids seed germination.

There are different methods of achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, and tracking. Factors to be considered in choosing a method are slope steepness, landowner desires regarding maintenance and future land use (mowing requirements, fire break, wildlife habitat, reforestation, etc.), and whether the slope is formed by cutting or filling.

1. Disturbed areas that will not require maintenance, such as mowing for wildlife habitat, may be stair-step graded, grooved, or left rough after filling.

2. Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each “step” catches material that sloughs from above and provides a level site where vegetation can become established.

3. Areas that will be mowed (these areas should have slopes less than 3:1) may have small furrows left by discing, harrowing, raking, or seed planting machinery (such as seed drill or sod seeder) operated on the contour.

4. It is important to avoid excessive compacting of the soil surface when scarifying. Tracking with bulldozer treads is preferable to not roughening at all, but is not as effective as other forms of roughening because the soil surface is severely compacted and runoff is increased.

Recommended Specifications

Cut Slope Areas

Cut slopes with a gradient steeper than 3:1 should be stair-step graded or grooved.

1. Stair-step grading may be carried out on any material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.

   The ratio of the vertical cut distance to the horizontal distance should be less than 1:1 and the horizontal portion of the "step" should slope toward the vertical wall (in-sloped).

   Individual vertical cuts should not be more than 30 inches on soft soil materials and not more than 40 inches in rocky materials.

2. Grooving is achieved by using machinery to create a series of ridges and depressions that run perpendicular to the slope (on the contour).

Grooves may be made with any appropriate implement that can be safely operated on the slope and that will not cause undue compaction. Suggested implements include discs, tillers, spring harrows, and teeth on the front-end loader bucket. Such grooves should not be less than 3 inches deep nor farther apart than 15 inches.

Fill Slope Application

Fill slopes with a gradient steeper than 3:1 should be grooved or be allowed to remain rough as they are constructed. Method 1 or 2 below may be used.

1. Groove according to number 2 above.

2. As lifts of the fill are constructed, soil and rock materials may be allowed to fall naturally onto the slope surface.

Colluvial materials (soil deposits at the base of slopes or from old streambeds) should not be used in fills because they flow when saturated.

Slopes should not be bladed or scraped to produce a smooth, hard surface.

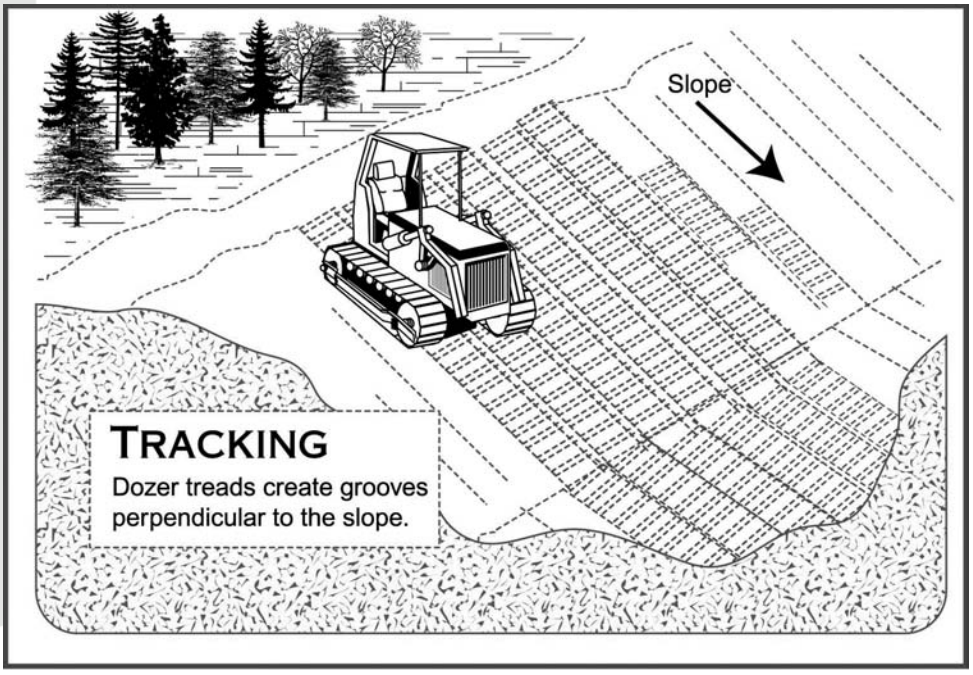
Steep slopes that will be mowed for wildlife habitat, maintenance, etc.

Mowed slopes (areas to be maintained as wildlife habitat, fire breaks, shoulders of access roads, etc.) should not be steeper than 3:1. Excessive roughness is undesirable where mowing is planned. These areas may be roughened with shallow grooves such as remain after tilling, discing, harrowing, raking, or after use of a cultipacker-seeder. The final pass of any such tillage implement shall be on the contour (perpendicular to the slope).

Grooves formed by such implements shall be not less than 1 inch deep and not farther than 12 inches apart. Fill slopes that are left rough as constructed may be smoothed with a dragline or pickchain to facilitate maintenance and/or mowing.

Roughening with Tracked Machinery – Roughening with tracked machinery on clay soils is not recommended. Undue compaction of surface soil results from this practice. Sandy soils do not compact severely, and may be tracked. In no case is tracking as effective as the other roughening methods described.

When tracking is the chosen surface roughening technique, it should be done by operating tracked machinery up and down the slope to leave horizontal depressions in the soil. As few passes as possible of the machinery should be made to minimize compaction.



Seeding – Roughened areas should be seeded and mulched as soon as possible to obtain optimum seed germination and seedling growth.